

Potamocorbula amurensis Spatial Distribution Survey

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The introduced Asian clam *Potamocorbula amurensis* was first detected in benthic samples from Suisun Bay in 1986. During the 1987-1992 drought, the clam spread quickly throughout the brackish regions of the delta, from San Francisco Bay as far east as Bradford and Twitchell islands in the western delta. Since its introduction to the delta, colonies of this clam have reached densities greater than 48,000 organisms per square meter. *P. amurensis* is an extremely efficient suspension feeder, filtering phytoplankton, bacterioplankton, and small zooplankton that would otherwise be available as a food source for larval fish and other important organisms.

In the fall of 1990, a dry year, the first *Potamocorbula amurensis* Spatial Distribution Survey (also referred to as "benthic blitz") was initiated to assess the potential impact of this exotic species and document its spread. The survey was designed to supplement data provided by the benthic monitoring component of the Interagency Comprehensive Water Quality Monitoring Program, which includes monthly grab samples in the delta and Suisun Bay. Survey sites were distributed at roughly 2-kilometer intervals throughout portions of San Pablo and Suisun bays, the major sloughs of Suisun Marsh, and the major channels of the western and west-central delta. The distribution survey was repeated in the fall of 1993, the first wet year since the discovery of *P. amurensis*, to record the clam's response to increased outflows.

In the spring of 1995, results from the Comprehensive Water Quality Monitoring Program benthic studies indicated that the extremely high outflows were affecting clam distribution and abundance. It was suggested that the established populations were experiencing high mortality due to scouring action and exposure to sustained freshwater outflow (Jan Thompson, USGS, Personal Communication). A third two-phase Spatial Distribution Survey was designed to document the response of *P. amurensis* populations to the intense pulsing of fresh water into the upper estuary.

The first phase consisted of a reduced survey, or "mini-blitz", sampling from only 43 of the original 214 distribution survey sites. The mini-blitz was conducted during the heavy runoff period in May 1995. The second phase included a full "benthic blitz" in the fall. During the fall survey, samples were collected from over 170 of the original survey sites during late September and early October 1995.

Figure 1 represents averaged data illustrating the size distribution and abundance of *Potamocorbula amurensis* from six geographical regions for all four surveys. The number of sampling sites varies between regions and between surveys. Table 1 shows the number of data points used in determining the averaged values for each survey.

Table 1
Data Points per Sampling Region

Region	Fall 1990	Fall 1993	Spring 1995	Fall 1995
San Pablo Bay	54	54	15	54
Carquinez Strait	7	7	3	7
Suisun Bay	33	33	12	32
Suisun Marsh	42	42	8	41
Sacramento River	15	16	2	7
San Joaquin River	24	24	2	5

In fall 1990, the greatest recruitment was seen in the Suisun Marsh region, where individual site densities reached 48,000 clams per square meter, and clam size was generally less than 4mm in shell width. Downstream in Carquinez Strait, many larger clams (8-12mm) were found. In fall 1993, after heavy spring flows, the recruitment zone had shifted downstream to San Pablo Bay. In 1993, moderate numbers of larger (9-16mm) clams were seen upstream, predominantly in Suisun Marsh.

In spring 1995, during a period of sustained high outflows, the number of clams found per square meter was reduced at all sites compared to previous studies. Though the seasonality and number of samples per region varies from previous studies, distribution patterns found in spring 1995 appear similar to those in the fall 1993 survey. Maximum recruitment was again in San Pablo Bay, where 1-10mm clams made up the bulk of the catch for the spring survey. Moderate numbers of larger clams were found upstream in the Suisun Marsh region. The presence of many dead clams, found with valves intact in Sacramento and San Joaquin River sites, suggests high winter and spring mortality due to sustained freshwater flow.

In the fall 1995 study, the area of highest clam density and the zone of greatest recruitment was in Suisun Bay. Density at one site in the western bay exceeded 45,000 organisms per square meter. Most individuals were less than 4mm. Moderate numbers of larger clams were found in San Pablo Bay, Carquinez Strait, and to a lesser